Softura

Tech Spend on

Industrialized ML

Introduction – Understanding Industrialized ML

Let me begin by asking you what is common between winning a game of Minecraft, developing a disease surveillance technique that will help humanity predict future pandemics, classifying 1000 supernovae autonomously, and predicting climate change performance of cities. If you answered that all of these were achieved by Machine Learning (ML), then you are way ahead of the curve.

Before we proceed, let's look at recent research findings to understand how AI/ML is gaining traction in the industry. McKinsey reported that industrialized ML has received investments of nearly $5 billion in 2021 compared to a $2 billion investment three years earlier. 50% of companies responded to a survey by Forbes that they are going to prioritize AI and ML in their IT budgets and 20% stated that they are planning to increase their spend on these technologies.

Early-stage venture capital firm, Toyota Ventures deployed an initial seed capital of $100 million dollars in AI startups such as Nauto which builds ML algorithms to predict and prevent traffic accidents, Common Sense Machines that uses ML to create 3D simulations, and Third Wave, an autonomous forklift company that combines ML, computer vision and automated material handling.

ML is emerging as a dominant discipline within Artificial Intelligence and the list of practical applications is growing every day. The most popular use cases for ML in an enterprise context are:

- **Smart Factories with Autonomous Operations**
- **Digital Twins and Predictive Maintenance**
- **Data Pipeline Automation and MLOps**

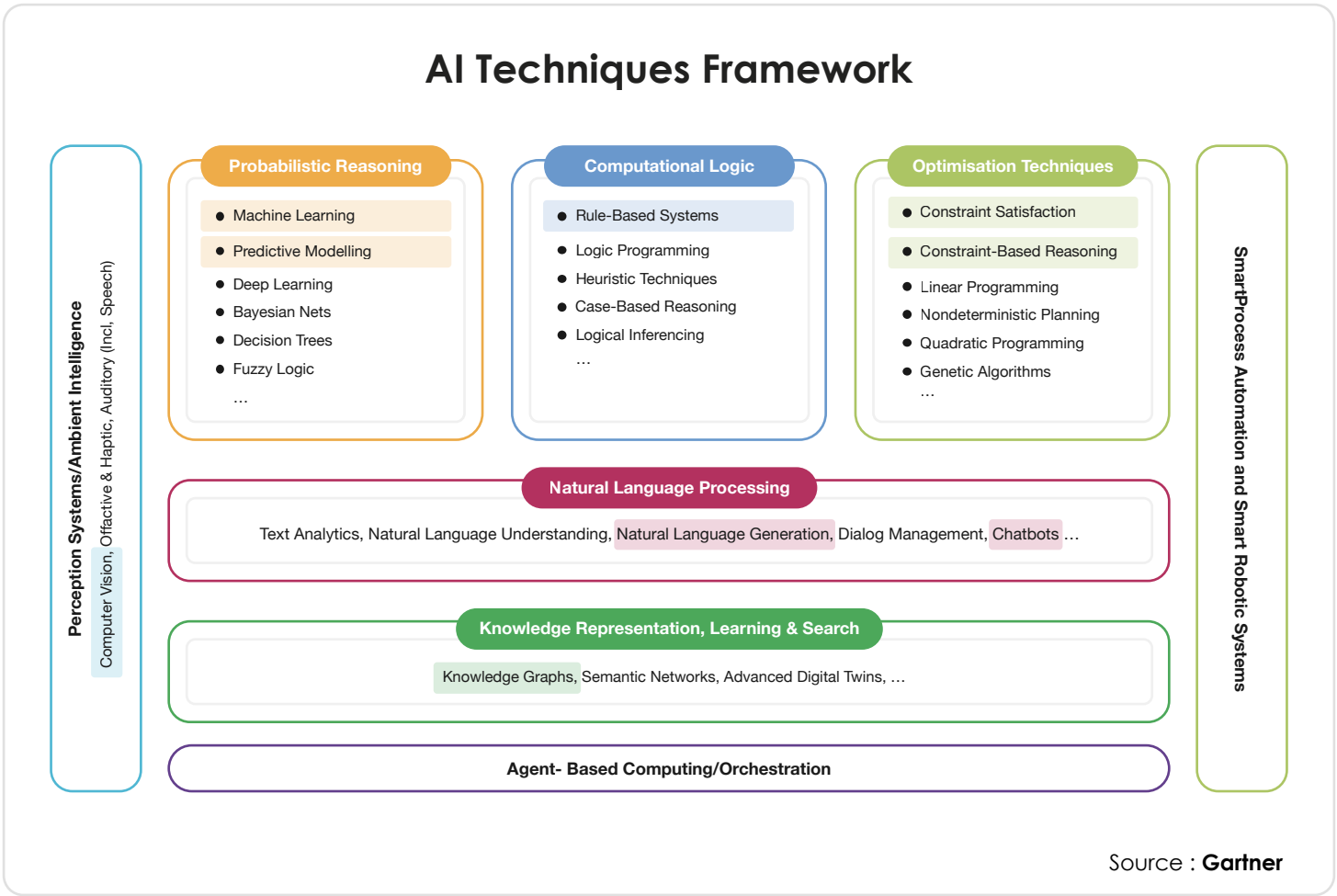
SAS, a global leader in data analytics, commissioned a study on "how to solve the data science skills shortage?" which had an interesting finding. 63% of tech leaders stated that their companies lack enough employees with ML skillsets, despite that fact that 54% of them are actively using ML to solve business challenges.

So, what does this mean to you?

If you are thinking about acquiring AI/ML skills or implementing ML in your company, then this article will point out how your peers are industrializing ML at scale using a combination of AI-optimized hardware and software.

Building Probabilistic Reasoning Capabilities

ML is a subset of probabilistic reasoning techniques that companies leverage to analyze data, detect patterns and predict events in an uncertain environment. ML models are formulas applied to a large volume of data to reveal insights that were "hidden" or not apparent. ML models leverage correlation by connecting relevant data points and applying logic to determine likelihood of occurrence of an event such as a machine failure or a weather event.



Source : **Gartner**

Let us understand how ML is enabling digital transformation at Bosch, a German multi-national engineering company with global operations and diverse product lines across mobility, home and industry segments.

Bosch Center for Artificial Intelligence is on a mission to use big data, machine learning, and deep learning techniques across Bosch's manufacturing, engineering and supply chain operations:

- Optimizing manufacturing operations by deploying ML models for product visual inspections, defects detection, root cause analysis, and production scheduling.
- Transforming engineering design with AI to extract insights from test/simulation data to improve design and performance of mobility and home technology solutions.
- Overcoming supply chain challenges using ML and Deep Learning models to forecast demand, optimize packaging sizes, and ensure availability of materials and products.

Smart Factories with Autonomous Operations

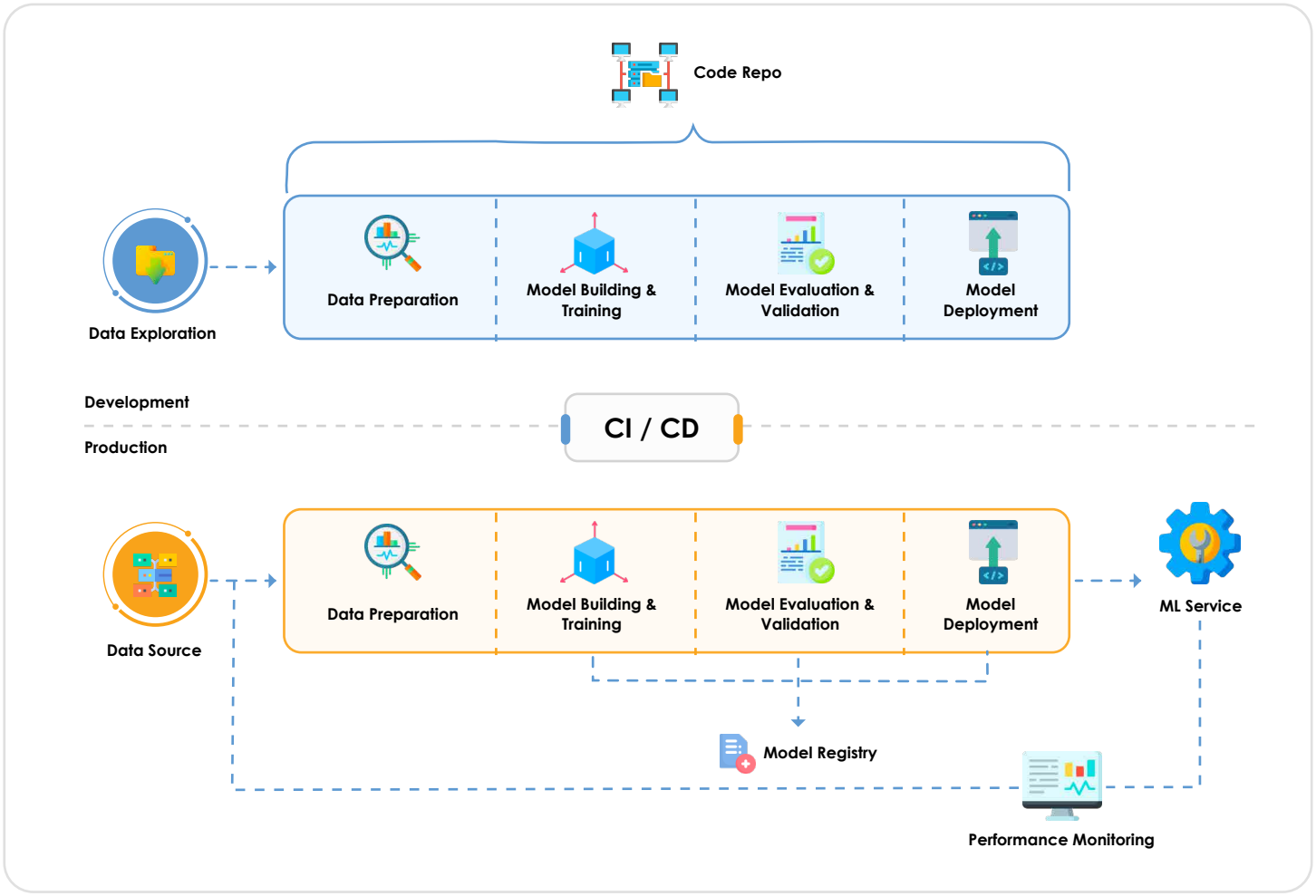
Geopolitical events post the pandemic have adversely impacted the supply chain and companies are reinventing ways to increase productivity and quality of products to meet changing customer preferences. According to research by Capgemini, 70% of manufacturers are adopting Smart Factories that are powered by cognitive technologies (AI/ML).

The concept of a Smart Factory is enabled by a convergence of different technologies such as:

- **Industrial Internet of Things (IIoT) :** Real-time data generated by a network of machines and equipment in the shop floor and telemetry data from vehicles.
- **Cloud and Edge Computing :** Cloud and edge computing where data is analyzed/mined by using experimental probabilistic reasoning techniques such as ML and deep learning to predict events.
- **ML Pipeline Automation using MLOps :** Continuous delivery and continuous integration of production-grade ML models that supports autonomous operations.

Investing in MLOps – Adoption and Benefits

According to Deloitte, MLOps market will reach $4 billion by 2025. MLOps is a term derived from DevOps which brought together software development teams and IT operations for the purpose of automating deployments. Similarly, ML engineering which represents development and training of ML models is combined with IT operations to form MLOps.



Challenges with traditional ML engineering approach:

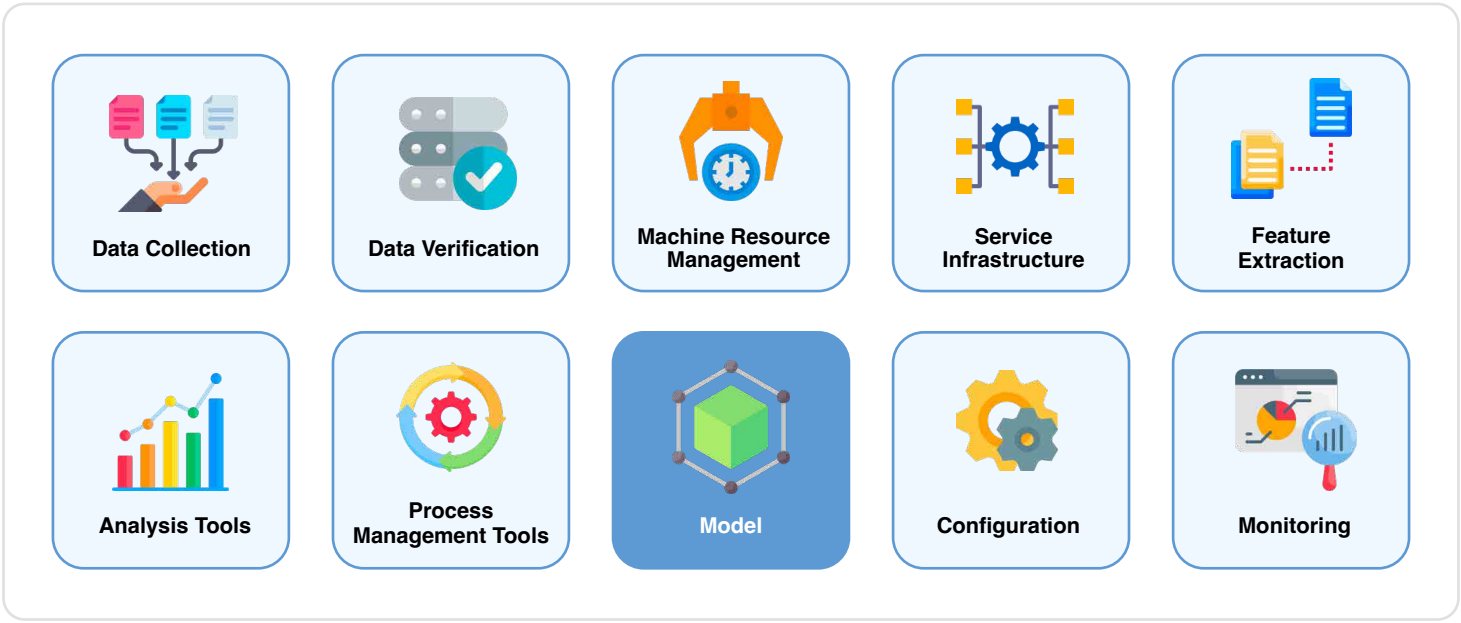
Experimental ML models are created to solve specific business problems or use cases and are not often integrated into the ML pipeline for maintenance. As per a Gartner report, less than half of ML models are going into production because of the following challenges:

- Shortage of ML skills
- Training loss due to "noise" in training data
- Generalization loss due to model complexity

Model complexity is a result of deploying advanced statistical concepts such as decision trees, parametric and non-parametric models to ensure that the model can predict events accurately.

MLOps to the rescue – automating ML pipeline

Before we proceed, let us understand what an ML pipeline is. ML pipeline consists of steps or stages involved in bringing ML models into production and begins with data collection and preparation, otherwise known as ingestion and cleaning. According to Google, data preparation is followed by model training, feature engineering, testing/validations, configuration, deployment, and monitoring.



MLOps successfully automates the ML pipeline to ensure human intervention is not required to take ML models into production.

Uber, a San Francisco based global mobility and technology company, successfully created an MLOps platform for internal use called as Uber Michelangelo. Michelangelo automates the end-to-end ML workflow for a wide number of use cases such as:

- Marketplace forecasts
- Customer support
- Calculate estimated time of arrival
- Chat feature on driver app

Michelangelo uses Apache Spark pipeline architecture and MLlib, a scalable machine learning library.

Hyperscalers Driving Industrialized ML Use Cases

Hyperscalers are world's leading cloud technology companies who provide Infrastructure-as-a-Service and Platform-as-a-Service to customers. The top 5 hyperscalers are: Microsoft Azure, Amazon Web Services, Google Cloud Platform, Meta (Facebook) and Alibaba. These companies are offering MLOps platform and managed services to their clients and driving use cases.

All these MLOps platforms offer full-service capabilities such as:

- Data Collection, Preparation and Ingestion: Azure Synapse, Amazon Ground Truth, Data Wrangler and Vertex AI Data Labelling
- Feature engineering support through a central repository to store and serve ML features
- Low-Code and No-Code GUI platforms for building ML models
- AutoML support to automate ML pipeline tasks
- Integrate pretrained ML APIs into enterprise applications

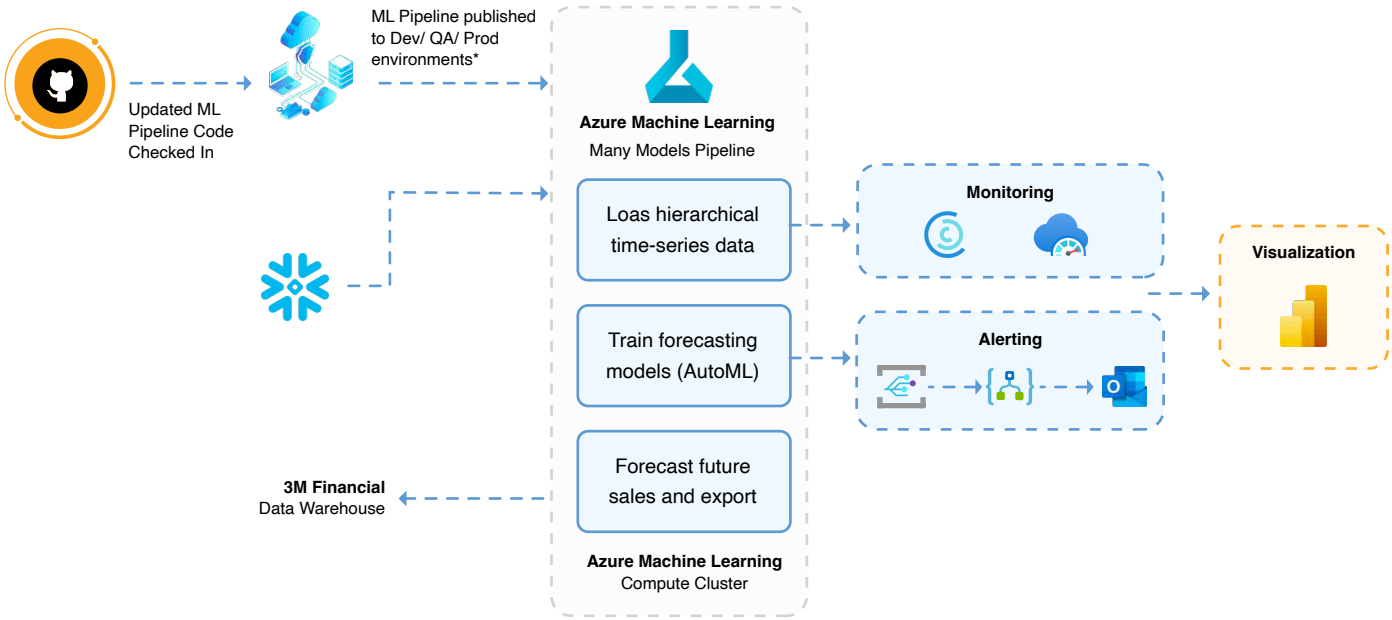
American multinational conglomerate 3M that has business operations across industry segments uses Microsoft Azure Machine Learning. When the Data Science Manager at 3M, Jeff Neilson was asked about the benefits of Azure ML platform, he said, ""As more of our groups rely on the Azure Machine Learning solution, our finance experts can focus more on higher-level tasks and spend less time on manual data collection and input."

How did 3M leverage Azure ML?

By using Azure ML and Azure Cognitive Services, 3M has developed and implemented 1500 Machine Learning models to automate sales forecasting across divisions and regions.

Let us analyze another problem unique to companies trying to implement MLOps at scale.

3M - Forecasting Architecture



CNA Insurance, 7th largest commercial insurer in the United States, had to respond to a common ML challenge: hundreds of complex ML models were getting deployed manually and took months which resulted in escalating costs. It also slowed down their time to market and people were discouraged from building new models.

CNA Insurance built a Machine Learning Model Factory leveraging Google Vertex AI that enabled data engineers across divisions to deploy complex forecasting modes in hours instead of weeks.

Last but not the least, we can look at innovative platforms and managed services offered by Amazon Web Services to support companies looking to automate MLOps across use cases:

- **Amazon SageMaker :** Development Environment and No-Code Interface for data science teams to bring ML models into production.
- **Amazon Rekognition :** Directly analyze videos and images without building ML models from scratch by leveraging custom-built computer vision APIs.
- **Amazon SageMaker Ground Truth and Data Wrangler :** Data Preparation, Verification and Detection of Anomalies prior to deploying ML models.

Conclusion – Scaling ML at Enterprise Level

Frank Braski, Senior Architect and Head of AI Practice at Softura, says, "Before you start building a business case and a roadmap for implementing MLOps at scale in your company, you will be better off to collect and classify use cases based on supervised and unsupervised ML."

Supervised ML uses labeled datasets while unsupervised ML analyzes unlabeled datasets to detect patterns. For use cases that require high accuracy it is better to label data and use supervised learning. For example, ML models for sales forecasting uses regression technique which is a supervised ML method.

However, in industrial scenarios, when machine learning models are used to analyze real-time complex data generated by machines, experts recommend using an unsupervised learning approach where human intervention is required to validate output. Another popular use case for unsupervised learning is when you need the ML model to provide product recommendations. Methods such as clustering and association is used to build recommendation engines.

Regardless of which industry you operate, MLOps will help you build and deliver thousands of complex ML models into production continuously.

In conclusion, Frank adds, "according to research, only 40% of companies agree that they are at the higher levels of AI maturity, having implemented AI/ML at scale to achieve operational, systemic and transformational goals. Industrializing ML by practicing MLOps and automating ML pipeline will ensure companies are able to extract real value from their data. This is a prerequisite to achieve greater cost savings, lesser risks, and faster time-to-market."

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